Electric cars: Policy

Lecture notes: Lecture 3.3

Decarbonisation requires innovations within the entire system: innovative mobility solutions, not only designed for transportation but also to support the operation of energy systems. In the transition towards low-carbon electricity systems, the increasing variable renewable energy sources are calling for more flexibility sources to cope with the uncertainty and variability that affects the *residual demand*. This means that *flexibility is needed* in the situations where there is a surplus in production (electricity generation, for example from solar and/or wind generation units, is higher than the usage at some moments in time) or a shortage (the demand is higher than the generation).

Flexibility

Normally, this flexibility can be offered by traditional players, through - among others - *energy storage* and *demand response*. Demand response concerns defining and using mechanisms that enable energy customers to *reduce or to shift electricity use* during periods of peak demand. The flexibility needs of the electricity systems also provide opportunities for new players from different sectors. With the continued electric vehicle adoption, their potential aggregated capacity can also be exploited in electricity markets. While plug-in EVs can play an important role in demand side management, fuel cell electric vehicles have the potential to *operate as highly flexible dispatchable power plants* as they can produce electricity. Fuel cell vehicles are all-electric vehicles that are powered using electricity generated on-board from a gaseous fuel, using a fuel cell stack. A small battery is used to store energy with regenerative braking—although it can be designed to have a bigger battery and a smaller fuel cell. The fuel for fuel cell electric vehicles can be natural gas or hydrogen, but the fuel cell vehicles currently being commercialised or under development use hydrogen.

Car as a Power Plant

The *Car as Power Plant (CaPP) concept*, investigated at the Delft University of Technology in the Netherlands, proposes an *integrated energy and transport system* that is based on the use of Fuel Cell Electric Vehicles (FCEVs) as flexible dispatchable power plants, and the use of hydrogen for storage variable renewable energy sources and as an energy carrier. The idea of using electric drive vehicles to provide electricity and services directly to the electricity grid or directly to the energy users was put forward through the concept of Vehicle-to-Grid (V2G) power. It can be done by plug-in EVs as well as by fuel cell electric vehicle. As mentioned earlier, FCEVs are the only type of electric vehicle that represent a new electricity generation source.

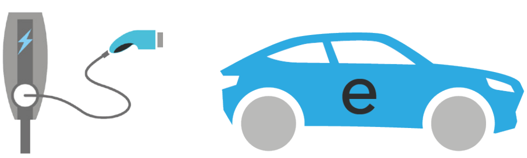
Figure: Car as a Powerplant installation at the Green Village at Delft University of Technology

Like stationary fuel cell systems, fuel cell electric vehicles can be used to *provide electricity when they are in stationary mode*. Thus, FCEV fleets that are parked can become dispatchable power plants and serve local loads or the electric grid. Therefore FCEV power can be used to *replace* the power that would be otherwise used from the grid, for example during peak hours. A single vehicle could power up to 100 households during peak time, while 500 cars could replace an entire power plant. The *net revenues* from FCEV-based power are represented by the net savings incurred through the use of FCEV power instead of grid power. This type of use of fuel cell vehicle is technically feasible and economically sound under certain circumstances and depends on many factors including the climate.

Please watch this short video produced by the Green Village, for a better understanding of the Car as a Power Plant concept.

Benefits

The potential benefit of realizing and using the system would be *achieving a more sustainable passenger transport system and a more flexible electricity supply* due to the use of electric cars to support the operation of electricity system. Whether these benefits can be materialized depends on a large variety of developments in the electric car technology, including fuel cells, the required new refuelling and charging infrastructure, the behaviour of potential users who need to offer their cars for the V2G system and introduction of *advanced electricity metering systems*. Irrespective the benefits of using the V2G technology, it remains in its infancy although the number of pilot projects worldwide is growing. To make this possible



incentives and policy measures are needed. Here we can think about mandates and/or subsidies as a way to support this technology directly, and additional incentives, for example to develop V2G standardization or to do fundamental and applied research. Also subsidies for V2G capable cars or chargers can be an important incentive to stimulate the technology adoption and usage. These subsidies are needed to bring costs down as to scale up the individual pilot projects to mass adaptation level.